MODIS SEMI-ANNUAL REPORT
- JUNE 1992 -
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RSMAS/MPO
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A. OBJECTIVES

A.1 Major Objectives

Major objectives for the MODIS infrared algorithm effort this year are to: interact with the MODIS instrument team, develop a portable calibration approach for the AVHRR radiometer, acquire, adapt and test various radiative transfer packages, put initial analysis capability in place, and start development of AVHRR atmospheric correction algorithms. The execution phase contract became effective January 15, 1992.

A.2 Near Term Objectives

The near term objectives consist of the following items: continue algorithmic development effort, expansion of modeling facilities, evaluation of global *in situ* validation field statistics and data assimilation approaches, and support of investigators.

B. OVERVIEW OF CURRENT PROGRESS

B.1 Team Interactions

B.1.1 Spring Team Meeting (14-16 April 1992)

Acted as Ocean Team Leader. Prepared 'straw-man' peer review proposal which was used as a basis for MODIS Team model. Developed Ocean Team position on Hughes-Santa Barbara proposed performance modifications for MODIS-N. Provided input to GSFC personnel concerning infrared band performance goals, margins, *etc.*

B.1.2 Ocean Team Meeting (20-22 May 1992)

Acted as joint host with Bob Evans for the meeting in Miami. Provided input into peer review and algorithm description documents. Continued discussions with Team members concerning MODIS-N performance trade-offs.

B.2 Validation Database Development

B.2.1 Relational Database Evaluation

Efforts have been made to evaluate the SQL/Relational Database Software for the Silicon Graphics 480 Powerserver. At this time, INGRIS appears as the prime candidate.

B.3 Processing Environment

B.3.1 Fiber optic [FDDI] Networks

An examination is underway to evaluate fiber optic [FDDI] networking. Processing environment - An examination is continuing to evaluate appropriate workstations/data servers for algorithm development activities.

B.3.2 Workstation Hardware

Specific hardware evaluations are planned for several new technology workstations. We have purchased additional computer hardware to facilitate algorithm development. Current workstation hardware is a mix of DECstation 5000/200, DECstation 5000/125, SGI PI and MAC IIci units.

B.3.3 Calibration activities

Efforts are continuing to validate a new approach to AVHRR calibration which removes non-linear artifacts by a simple linear transformation on scene temperature that produces a correction accurate to the least count level. Results of this approach are being evaluated using the East Coast HRPT matchup datasets assembled for the AVHRR Pathfinder.

B.3.4 Algorithm activities

Efforts are continuing to develop a new suite of AVHRR atmospheric correction algorithms and evaluate them using the matchup datasets assembled for the AVHRR Pathfinder.

i. An improved functional form for atmospheric corrections in the infrared.

ii. Test and evaluation of atmospheric correction procedures using the RAL and Lowtran codes.

iii. We have acquired code suites for MODTRAN, FASTCODE and HYTRAN in order to evaluate them against the RAL and LOWTRAN codes.

B.3.5 Characterization of *in situ* validation fields

Efforts are continuing to generate statistics on AVHRR and *in situ* SST fields (based on MCSST and NOAA COADS datasets). Fields are being evaluated individually and jointly (see abstract in last section).

B.4. INVESTIGATOR SUPPORT

B.4.1 JANUARY

B.3.1.1 O. Brown - Team related effort

B.4.2 FEBRUARY

B.4.2.1 O. Brown - Team related effort
B.4.2.2 G. Halliwell - Analyses efforts

B.4.3 MARCH

B.4.3.1 O. Brown - Team related effort
B.4.3.2 G. Halliwell - Analyses efforts

B.4.4 APRIL

B.4.4.1 O. Brown - Team related effort
B.4.4.2 G. Halliwell - Analyses efforts

B.4.5 MAY

B.4.5.1 O. Brown - Team related effort
B.4.5.2 G. Halliwell - Analyses efforts

B.4.6 JUNE

B.4.6.1 O. Brown - Team related effort
B.4.6.2 G. Halliwell - Analyses efforts

B.5 ACCOMPLISHMENTS

B.5.1 Publications and Articles

Submission of various publications on AVHRR calibration, analysis of historical *in situ* and MCSST satellite derived SSTs, and data assimilation methodologies for satellite derived SSTs.

B.5.2 MODIS Team Meeting.

B.5.2.1 Preparation for MODIS Team Meeting.
B.5.2.2 Participation in MODIS Team Meeting.
B.5.2.3 Generation of 'strawman' peer-review process for Team consideration.
B.5.2.4 Evaluation of SBRC proposed changes in MODIS-N filter specifications.
B.5.2.5 Comment on infrared performance issues for SST bands on MODIS-N.
B.5.2.6 Moderation of MODIS Ocean Team meetings during the Team meeting.
B.5.2.7 Propose/plan MODIS Ocean Team meeting for late May in Miami.

C. Future Activities

C.1 Database Activities

C.1.1 Develop and test distributed database concepts.
C.1.2 Complete evaluation of SQL/Relational Database Software; pursue acquisition.

C.2 Processing Environment

C.2.1 Complete evaluation of FDDI; pursue acquisition.
C.2.2 Complete installation of new workstations and related hardware.

C.3 Investigator Support - Continue current efforts.

C.4 Algorithms

C.4.1 Develop and test East Coast algorithms on global retrievals.
C.4.2 Evaluation of global data assimilation.
C.4.3 Develop and test East Coast algorithms on global retrievals.
C.4.4 Evaluation of global data assimilation.

D. Problems

Travel: Due to changes in Federal and airline travel regulations we are unable to use GSA fares between Washington/Baltimore and Miami. This has increased travel costs by a factor of three without and increase in funding making future travel planning difficult.

E. PUBLICATIONS

Submitted for publication and in final review: "Calibration of AVHRR Infrared Observations: a New Approach to Non-linear Correction", J.W. Brown, O.B. Brown, and R.H. Evans, Division of Meteorology and Physical Oceanography, Rosenstiel School of Marine and Atmospheric Science, University of Miami.

Abstract: A detailed re-analysis of the calibration procedures for the NOAA Advanced Very High Resolution Radiometer (AVHRR) based on thermal vacuum test data was performed as part of the NASA/NOAA AVHRR Pathfinder Project. This effort, a follow-up to Brown *et al.* [1985], was motivated by the finding that the AVHRR instruments on several NOAA platforms have been routinely operated outside the range of thermal vacuum test results, and thus one could not interpolate non-linear corrections directly from earlier methods. These new calibration procedures permit calculation of non-linear temperature corrections for any AVHRR operating temperature based on a second order polynomial regression with a total calibration accuracy relative to an external calibration standard of less than two digital counts (0.2°C). Such an improvement is quite important to the absolute accuracy of surface thermal fields which are derived from these data utilizing various multi-channel atmospheric water vapor correction schemes. We find systematic differences in the newly derived non-linear correction results and those reported previously by Weinreb *et al.* [1990], and the original reference material in the various *addenda* to NOAA NESS TM 107 [Lauritson *et al.* 1979]. Calibration results for various AVHRR radiometers show instrument similar corrections for each band. Radiometers on NOAA platforms 8-12 demonstrate similar non-linearities.

Presented at: International COADS Workshop, Boulder, CO, January 1992
In final review for publication.
"Preliminary Comparison of North Atlantic SST Anomalies Between COADS and AVHRR-Derived Fields", G. R. Halliwell, Jr. Division of Meteorology and Physical Oceanography, Rosenstiel School of Marine and Atmospheric Science, University of Miami.

Abstract: SST maps of reasonable quality have been available continuously from shortly after World War II to the present from the Cooperative Ocean-Atmosphere Dataset (COADS). Since late 1981, a global SST dataset of reasonable quality (the Multi-Channel SST, or MCSST, product) has been generated from satellite AVHRR infrared images. Errors present in both of these products limit their usefulness for studies of climate in general, and for studies of the dynamical processes that force SST anomaly (SSTA) variability in particular. Significant improvements in the quality of these SST datasets are anticipated over the next few years. It therefore seems reasonable to determine the quality of the currently-available products to assess their present strengths and limitations and to provide a benchmark against which the future improvements in quality can be assessed. The present study focuses on one aspect of this work: characterizing the impact that errors present in these SST products will have on studies designed to quantify the influence of different dynamical processes on SSTA variability. The relative importance of different dynamical processes in forcing SSTA variability depends on factors such as location, season, and the space time scales of the variability. Consequently, the dependence of errors on these factors are assessed for both datasets by statistically comparing both sets of monthly SST maps (with MCSST SST retrievals averaged onto the 2° COADS grid) over the time interval 1984-89. The analyses revealed regions in the Atlantic, primarily in the North Atlantic, where both COADS and MCSST SSTA fields are highly coherent and thus represent large-scale SSTA variability with reasonable accuracy. They also revealed regions where both COADS

and MCSST SSTA fields are poorly coherent and characterized errors peculiar to each dataset.

The primary conclusions are that MCSST fields appear to resolve SST anomaly variability with wavelengths of 1000 to a few thousand kilometers and periods exceeding several months reasonably well. COADS fields only resolve these scales reasonably well in regions, primarily in the Northern Hemisphere, where sampling is sufficiently dense in space and time. Poor sampling is a particularly bad problem in the tropical Atlantic where SSTA variability is not as energetic as in other regions. In the subtropical Atlantic, where coherence between the datasets was relatively large for wavelengths exceeding 1000 km, an eddy-forced SSTA response with wavelengths of 1000-2000 km was detected in both datasets, although marginally in the COADS dataset. Biases between the two datasets are only a significant problem at very large basin-wide scales. At some latitudes, a large annual cycle exists in this bias due to an annual cycle present in zonally-averaged MCSST SST. Substantially improved COADS and MCSST datasets will become available in the near future; repeating the tests described here will quantify the degree of improvement and identify the limitations of both datasets for planned studies of SSTA variability in the Atlantic.

In press in Deep-Sea Research, “Efficient objective analysis of dynamically heterogeneous and nonstationary fields via the parameter matrix”, A. J. Mariano and O. B. Brown, Rosenstiel School of Marine and Atmospheric Science, University of Miami

Abstract: We develop a generalized approach for the objective analysis of nonstationary, heteorogeneous fields. An algorithm is presented that uses an anisotropic, time-dependent correlation function with correlation parameters that vary in space/time and a time-dependent trend surface for efficient objective analysis of dynamically heteorogeneous and nonstationary fields. The algorithm, which we term the “parameter matrix algorithm”, is applied to two data sets. The first is tropical Pacific sea surface

temperature (SST) derived from satellite AVHRR data and Pan-Toga drifting buoys. The SST application illustrates how the parameter matrix is used for the computationally efficient objective analysis of the tropical Pacific SST from 30°S to 30°N at 0.2° resolution (over 290,000 grid points) using approximately 350,000 data points from 12 2-day satellite SST composites. The second example uses data from the Anatomy of a Meander/BIOSYNOP experiment in the Gulf Stream ring and meander region and illustrates that an objective analysis using the parameter matrix can yield a more accurate representation of oceanic features than typical objective analysis techniques.